IMPROVED OPTIC CABLE MANAGEMENT

I. CROSS-REFERENCE TO RELATED PATENT APPLICATION

The present application is filed as a continuation-in-part of U.S. patent application Serial No. 07/387,978 filed July 31, 1989, and entitled "Optic Cable Management System." PAT. NO. 5,067,678 issued 11.26.91, and a continuation of application S.N. 07/678131, filed 4.1.91, Abnd

II. BACKGROUND OF THE INVENTION

1. Field of the Invention

This application pertains to a system for the management and routing of optical fiber cables. More particularly, this application pertains to an optical fiber routing system which is easily modified and which includes a novel coupling for joining troughs and fittings.

2. Background of the Invention

In the telecommunications industry, the use of optical fibers for signal transmissions is accelerating. With the increased utilization of optical fiber systems, optical fiber cable management requires industry attention.

One area of optical fiber management that is necessary is the routing of optical fibers from one piece of equipment to another. For example, in a telecommunications facility, optical fiber cables may be routed between fiber distribution equipment and optical line terminating equipment. In buildings and other structures which carry such equipment, the cable routing can take place in concealed ceiling areas or in any other manner to route cables from one location to another.

When routing optical fibers, it is desirable that any routing system will be readily modifiable and adaptable to changes in equipment needs. Accordingly, a routing system is not practical that would require a high capital outlay and that could not be readily adapted to changes in a customer's needs. Namely, if routing paths, once

established, are forever fixed, the system cannot adapt. Also, and perhaps most importantly, any routing system must protect optical fibers from damage. In the use of optical fibers, it is recognized that the fibers should not be bent beyond a minimum radius of curvature. For example, it is commonly recognized that optical fibers should not be bent in a radius of less than 1.5 inches.

The aforementioned U.S. patent application Serial No. 07/387,978 teaches an optic cable management system which includes a plurality of troughs and fittings. The troughs are extruded such that they can be cut to any length and present the same attachment end. The present invention pertains to an improved coupling for use in a system such as that shown in Serial No. 07/387,978 and additional improvements to such a system.

III. SUMMARY OF THE INVENTION

According to a preferred embodiment of the present invention, a cable routing system is disclosed for routing optical fiber cables between optical transmission equipment. The system includes a plurality of cable pathway-defining elements, including a plurality of troughs and fittings. Each one of the plurality of elements terminates at an attachment end. A novel coupling is described for joining at least a first one of said attachment ends to at least a second one of said attachment ends. A novel coupling includes an alignment means for aligning the first and second attachment ends in a predetermined alignment. Clamp means are provided for automatically clamping the attachment ends to the coupling upon alignment.

IV. BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a side elevation view of a portion of a cable management system including a cable trough coupled to a horizontal-to-vertical transition fitting;

Fig. 2 is a perspective view of a coupling for joining fittings and troughs of the cable management system;

Fig. 3 is a side elevation view of the coupling of Fig. 2;

Fig. 4 is a top plan view of two fittings being joined by the coupling of Fig. 2, with covers of the fittings being partially exposed;

Fig. 5A is an enlarged view of one side of the coupling shown in Fig. 5 with a side wall of an attached fitting shown inserted only in the right side of the coupling;

Fig. 5 is an enlarged view of the coupling of Fig. 4;

Fig. 6 is an end view of a coupling having one fitting attached and with a fitting lid in place;

Fig. 7 is a top plan view of the coupling of Fig. 2;

Fig. 8 is a bottom plan view of the coupling of Fig. 2;

Fig. 9 is a side elevation view of the coupling of Fig. 2;

Fig. 10 is a perspective view of a horizontal-to-vertical transition fitting;

Fig. 11 is a front end view of the fitting of Fig. 10;

Fig. 12 is a rear end view of the fitting of Fig. 10;

Fig. 13 is a top plan view of the fitting of Fig. 10;

Fig. 14 is a bottom plan view of the fitting of Fig. 10;

Fig. 15 is a right side elevation view of the fitting of Fig. 10;

Fig. 16 is a left side elevation view of the fitting of Fig. 10;

Fig. 17 is a perspective view of a fiber trough attached to a rigid support member; and

Fig. 18 is a front elevation view of the view of Fig. 17.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the several drawing figures in which identical elements are numbered identically throughout, an optical fiber cable routing system is disclosed. The system may include a plurality of elements, including a plurality of troughs 10 which may be connected to a plurality of fittings (such as horizontal-to-vertical transition fitting 12). Couplings 14 are provided for joining troughs together, fittings together, or for joining troughs to fittings.

Each of the troughs is formed from extruded plastic. A trough is partially shown in Fig. 17 as including generally vertical side walls 16 joined by a horizontal bottom wall 18. The walls 16, 18 cooperate to define a trough interior 20. The interior 20 functions as a cable pathway through which optical fiber cables may travel.

In addition to the troughs 10 defining pathways 20, various fittings can define pathways. For example, Fig. 4 shows a T-fitting 22 connected to a reducing fitting 24 by means of a coupling 14.

Fitting 22 includes side walls 26 and bottom wall 28, which define a fitting cable pathway 30. Similarly,

fitting 24 includes side walls 32 and bottom wall 34, which define the cable pathway 36.

Lids 38, 40 are provided for covering pathways 30, 36 and may be snapped on to the side walls 26. For example, Fig. 6 shows a lid 38 connected to the side walls 26 of T-fitting 22. Further, the side walls 16 of troughs 10 may be provided with clip ends 42 (see Fig. 17), which may be used to snap on to lids (not shown) of the troughs 10.

It will be appreciated that an optic cable management system having troughs and fittings forms no part of this invention per se. Such a system is shown in my commonly assigned and copending U.S. patent application Serial No. 07/387,978 filed July 31, 1989. The present invention pertains to various improvements to such a system, including a novel coupling mechanism for quick-coupling troughs and fitting.

With best reference to Figs. 1-9, a novel coupling 14 is shown in detail. The coupling 14 includes both alignment and clamping features.

Coupling 14 includes internal side walls 48 and internal bottom wall 50. Side walls 48 and bottom wall 50 cooperate to define a cable pathway 52. The coupling 14 also includes outer side walls 52, joined by an outer bottom wall 54. Side walls 52 and bottom wall 54 are retained in spaced parallel relation to side walls 48, 50 by a centrally disposed spacing rib 56. The walls 48, 50 and 52, 54 cooperate to define a generally U-shaped space 58, which includes side wall spaces 57 and bottom wall space 59 sized to receive bottom and side walls, respectively, of fittings and troughs.

Each of the troughs 10 and fittings (such as fittings 22, 24, or 12) terminate at attachment ends. The attachment ends of the fittings are shown generally at 60

(e.g., see Fig. 4). The attachment end of the trough is shown generally at 62 in Fig. 17. The attachment ends have generally the same U-shaped configuration and dimensions such that the attachment ends may be received within spaces 58. For example, a trough 10 may be attached to coupling 14 by slidably locating bottom wall 18 and side wall 16 into spaces 59, 57, respectively. Similarly, fitting 22 can be received within coupler 14, with side walls 26 received within space 57 and with bottom wall 28 received within space 59. Any other fittings may be received within coupling with the side walls of the fittings received within space 57 and with the bottom walls of the fittings received within space 59.

The receipt of the attachment ends within the coupling 14 results in alignment of couplings and troughs connected to fitting 14. For example, with reference to Fig. 4, with attachment ends 60 received within opposite sides of the coupling 14, cable receiving pathway 30 is in communication with cable-receiving pathway 36 via pathway 52. With the attachment of Fig. 1, the cable-receiving pathway of the trough 10 is connected to the cable-receiving pathway of the fitting 12.

In addition to aligning fittings or troughs, the coupling 14 attaches to the attachment ends of the fittings and troughs to securely receive the attachment ends within the coupling 14. Shown best in Figs. 5-7, leaf springs 61 are carried by the coupling 14, with the leaf springs 61 placed within side space 57 on opposite sides of the coupling 14.

As shown best in Fig. 5A, the leaf springs 61 include first and second halves 62, 64 disposed on opposite sides of spacing rib 56. (In Fig. 5A, side wall 32 is removed.) The springs 62, 64 are biased toward internal walls 48. The springs have terminal ends 65, which are

bent back to permit a leading end of the attachment ends to be inserted within the space 57. Upon sliding of the attachment ends into the space 58, the leading ends of the walls 26 force the springs away from walls 48.

The springs 61 are metallic and include cutout tabs 66, which project toward walls 57 and are angled into the direction of spacing wall 56. The tabs 66 act as knife edges, which cut into the plastic of a trough or a fitting wall (such as walls 26 in Figs. 5 and 5A) to bite into the walls 26 and prevent the walls 26 from being drawn out of the coupling 14. As a result, the clamping means not only includes the spring bias to hold fittings or troughs within the coupling 14. Instead, the clamping also includes the knife action of tabs 66 to bite into the material of the fittings or troughs to retain the fittings or troughs securely within the coupling 14.

Clips 70 extend upwardly from side walls 52 and are sized to engage the roof of a lid 38 (such as that shown in Figs. 5 or 6) to securely hold the lid 38 in place. The clips 70 are resilient and may be spaced apart to remove the lid 38.

In the present invention, there is also shown a novel support mechanism for supporting troughs 10. Accordingly, attention is now directed to Figs. 17 and 18.

Each of the troughs 10 is extruded plastic and may be cut to its desired length. Regardless of where the cut is made, each of the troughs 10 presents an identical cross-sectional profile at the terminal end 62. Accordingly, no matter where the trough is cut, its terminal end 62 will be adequately shaped to be received within a coupling 14.

A rigid support plate 74 is provided to be received against the bottom or exterior surface of bottom wall 18. The plate 74 is preferably made from extruded

metal (such as aluminum). The plate 74 includes an upper surface 76 and a bottom surface 78, with a plurality of rails joining the bottom to top surface, including outer rails 80 and inner rails 82. Rails 80 are spaced apart to define a longitudinally extending slot 84 opening through the bottom wall 78. Rails 82 are spaced apart to define longitudinally extending slot 86 opening through upper wall 76. Each of the opposing surfaces of rails 80 and 82 include internal grooves 88, which extend longitudinally. The grooves 88 are shaped to threadably receive the threads of standard bolts 90, 92.

The support 74 is extruded. As a result, no matter where it is cut, the same thread profile is presented. Therefore, bolts 90, 92 may be threadably received within slots 84, 86 at any location along the length of support structure 74. Slots 93 are formed in bottom wall 18 of trough 10 to be aligned with slot 86. As a result, trough 10 may be secured to support 74 by simply receiving a bolt 92 through the slots 93. Any rigid mounting bracket (not shown) may be connected to the support 74 by bolts 90 to secure the support 74 to a ceiling or other structure.

The vertical-to-horizontal transition fitting 12 is shown in detail in Figs. 10-16. The fitting 12 includes right and left side walls 100, 102, respectively. Side wall 100 includes first and second portions 101, 103. The side walls 100, 102 are joined by a rear wall 104 and an arcuate bottom wall 106. Arcuate bottom wall 106 is selected to have a radius of curvature of not less than 1.5 inches to prevent damage to optical fibers lined against wall 106.

The walls 100, 102, 104, and 106 cooperate to define a cable pathway 108, including a horizontal pathway 110 and a vertical pathway 112 extending between attachment

ends 111 and 113. Pathway 110 opens upwardly, and pathway 112 opens toward a side opposite back wall 108. A vertical slot 114 is provided through side wall 100 separating portion 101 from portion 103. The slot 114 permits placement of fibers within pathway 108. A gap 116 extends between side wall portions 101 and 103 such that a fiber may extend completely through pathway 112, gap 116, and slot 114.

With the structure of fitting 112 as described, a horizontal trough may be connected to end 111. A vertical trough may be connected to end 113 via coupling 14. The fibers from the horizontal trough may be connected to the fibers of the vertical trough by simply pulling the fibers through slot 114 and passing them through gap 116 to place them in the vertical pathway defined by the vertical trough.

From the foregoing detailed description of the present invention, it has been shown how the invention has been obtained in a preferred manner. However, modifications and equivalents of the disclosed concepts, such as those that readily occur to one skilled in the art, are intended to be included within the scope of this invention.

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